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# The Engineering Experiment Station

## "The Most Interesting Spot in the Engineering Group"

*By* DAVID B. CHANCELLOR, '30

### I. THE BUILDING

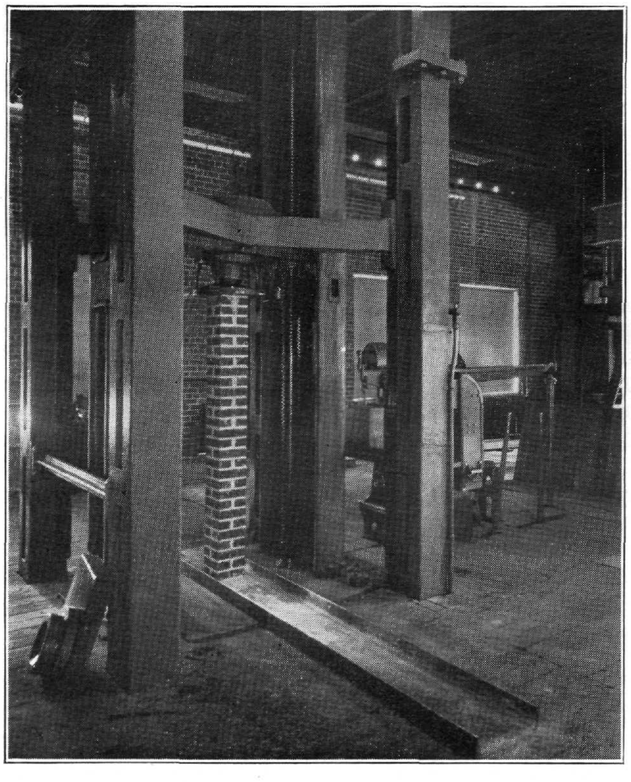
ASK any student in the Engineering College (freshmen of limited experience of course excepted) the location of the Engineering Experiment Station. "Sure," he'll say, "the tall building on Woodruff Avenue, just east of the Industrial Engineering shops. Four stories, brick with white stone trim, lots of windows."

Now that locates the Engineering Experiment Station Building, a structure designed and built entirely for general engineering research work and incidentally the first of its kind among the universities of the country. The Engineering Experiment Station, though, is more inclusive, for it takes in the whole Engineering College, the laboratories and equipment of the departments, with the experimental brick plant at Roseville thrown in. And even the University Power Plant has been used for some of the experiments. Why the whole State of Ohio is a laboratory, at least it was for the "Climatological History of Ohio," the thickest bulletin yet issued by the Station.

To put it in a nutshell, the Engineering Experiment Station with its all-inclusive equipment is an organization for finding out new things about engineering. But this story is just about the Building, the most tangible evidence of the whole research organization.

"Brick with white stone trim, lots of windows."

The Engineering Experiment Station



The 500,000-pound Column Testing Machine

That's the exterior. And most of you know the interior, for some classes in precise surveying concrete design, and mechanics meet in the building, and the Roundup in all its hilarity has imposed on the beams and columns of the testing machine room a weight of mirth and men which might have been a severe strain on a less sturdy structure. No danger, though, in the Experiment Station Building; the floors are reinforced concrete and the framework is massive structural steel. Excepting the Stadium, this was the first steel framed structure on the campus. Much of the steel of the Experiment Station is right out in the open, too, a little bit rough, perhaps, but expressive of the uses and purposes of the building, and a practical lesson in the use of riveted joints and of members built up from plates and channels and angles.

This steel has an interesting history. Plans had been made for the Engineering Experiment Station Building but no money was available. The University Business Manager who was arranging for the purchase of the equipment which had been intended for the power plant at Langley Field, Virginia, telegraphed Professor Clyde T. Morris inquiring whether the steel for the power plant structure could also be used. "Yes," wired back Professor Morris. And so the steel was bought, of course at a substantial saving, and the building was designed all over again to fit the material on hand. Professor J. R. Shank, of the Civil Engineering Department knows the building better than anyone else for he did the designing.

The foundations of the structure are of concrete, the facing is of red brick, the floors are reinforced concrete, and the window frames are of steel, therefore the building is fire-proof with the exception of the roof, which is slow burning. It is 103 by 134 feet, has four stories with a total floor space of approximately 40,000 square feet.

That's nearly an acre of floor space. But ultimately, when plans are carried out, additions will be made so that the completed Station will be about five times as large.

The building has two divisions. The first division comprises the main testing room which houses the large testing machines. This room has removable floor-sections which give the full height of the building for certain lines of research work, such as testing steel columns. This main testing room is 42 feet wide and 101 feet long. It is equipped with a traveling crane of eight tons capacity for the unloading and handling of heavy material.

The second division of the building is the four story section which contains a total of 40 rooms, providing offices and research rooms for cement and concrete testing, timber treatment, metallurgical processes, chemical engineering research, gas and fuel investigations, road materials testing and highway research. There are two conference or lecture rooms as well. In this division are housed the State Highway Testing Laboratories, The Federal Bureau of Roads Cooperative Subsoil Survey, and the Water Resources Branch of the United States Geological Survey which is making a water survey of Ohio.

The ground floor of the building is provided with a passageway of sufficient size to permit the driving of trucks, and there has also been installed an electrically bonded industrial track with turntable to permit the convenient handling and placing of heavy material. There is also a secondary lift so that heavy equipment can be placed on the fourth floor which is at the same level as the traveling crane rail.

One of the interesting rooms in the Station is the Constant Humidity Room where concrete specimens from roads are kept. The room has a large storage capacity, and is kept damp all the time by a fine spray of water. The aggregate room has large drums, motor driven, into which stones are put to see how much they will wear down in a given time. The cement testing laboratory has room for 35 students, and contains a Fairbanks testing machine, an Olson 50,000-lb. testing machine, briquette moulds, sieves, screens and apparatus for making steam tests on cement. There is coal separation and metallurgical equipment in the metallurgical research room, and in the timber treatment room is the open and closed tank system with high pressure boiler and other necessary equipment.

The gas laboratory of the Department of Metallurgy has gas meters, gas purifiers, and gas scrubbers, all used in connection with a vertical one ton capacity gas retort which is located outside the building. The road materials laboratory consisting of three rooms contains a cementation impact machine, core drill, saw and grinding lap, briquette moulding machine, constant temperature bath, electric ovens, sensitive balances, etc.

Such, briefly sketched, is the equipment of the building. The more important parts of this equipment will be discussed in detail in the sections which are to follow.

## II. THE BATTERY OF TESTING MACHINES

In the main testing room of the Engineering Experiment Station Building are three great machines for testing columns and beams. All of them work on the principle of a pair of scales with a knife edge, and are run by electric motors. And all three were made by the Riehle Bros.' Testing Machine Company of Philadelphia.

One of the machines is a three-screw 1,000,000 lb. compression and tension machine, whose strength is sufficient to pull apart a soft steel bar 8"x2" thick. It is run by a 25 h. p. Westinghouse electric motor. There are only about three of these machines in the country, and they have to be built to order, as no company keeps them in stock.

The next machine is a two-screw 500,000 lb. column testing machine, which is run by a 10 h. p. Westinghouse electric motor. This machine is capable of testing columns 25 ft. high.

The third unit is a three-screw 400,000 lb. tension, compression, and a shear machine which is powered by a Westinghouse 10 h. p. electric motor. This machine will test beams 20 ft. long, and is provided with supports so that the load can be applied to the side instead of to the end of the specimen. Bending out of line and deformation (the bottom of the beam stretches, the top shortens) can then be measured.

The motors and gears for the 1,000,000 pound and the 400,000 pound machines are on concrete foundations above the floor level, the 500,000 pound machine has a concrete foundation below the floor level for its motor, because, if the machine were higher, it would interfere with the operation of the overhead crane.

Imagine a test with one of the machines, say the million-pound one. Five hundred tons is a heavy squeeze or a strong pull, (of course it works both ways) more than the weight of the world's heavist locomotive. You can guess what it will do to a tile wall. The head touches the top of the specimen, just fits snugly at first. Then the pressure begins to be applied. The test specimen rests on a platform supported on "knife edges" at the short end of a lever system. (You can't say these triangular blocks are very keen knife edges, but they do allow free motion of the parts.) The fulcrum has other knife edges, and the long end of the lever is graduated in figures and has a movable poise. Platform scales, of course. Put the specimen in, balance the scales, apply the pressure, and measure its force. The motor hums, the gears turn visibly, but so transformed is the motion that the immense screws appear to be stationary and their movement can be detected only by observing closely a mark on a screw and a point on the platform. The machine was originally set up so that the head had a slow motion of 1/10 in. per minute, but it was found that so much speed on a wall was like a hammer blow, so new gears are being installed which will bring the motion down to .03 in. per minute. The 400,000 and 500,000 lb. machines have a maximum speed of 8 inches per minute, a minimum of .05 per minute.

Down comes the head, the scale beam rises, and the counter poise must be turned farther and farther out on the beam to keep the moments equal and measure the load. Perhaps there's a slight readjustment at first, then nothing appears

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to happen. It's a lively time for the molecules of the tile and mortar, however. We cannot know but we can imagine the shifts and eddies of strain and pressure, strong parts carrying the load of weak parts, compensation, a regular clearing house of forces, for the visible component is the load carried which we can measure on the beam. That is just what happens when a wall is loaded in actual use, so by delicate instruments we can measure the changes in size and length. Then we can go farther—for no one expects a wall actually to break in service—see what load is required for failure. Slight cracking noises are evidence that some parts have found the strain too hard to bear. Then visible cracks appear, and it is interesting to see whether they have the location and direction which they should according to theory.

Then comes the failure. The particles can on longer stand the load, they get out of its way instead and down goes the scale beam, for less load is carried by the wall. Perhaps the failure is quiet, perhaps a section of the wall breaks off and falls with a crash.

Suppose that the highest load measured in the test was 891,000 lbs. But how do you know that this immense weight has been accurately measured? Take it for granted that the machine, as supplied by the manufacturer, is accurate? Of course it was tested before it left the factory, but scientific instruments must always be checked for accuracy. So the machines had to be calibrated. The accuracy of the machine might be checked by piling a known weight of pigiron on the platform and reading the scale, but engineers have found better ways than that.

Mr. Harry D. Foster, who is investigating ceramic building materials at the Station, had charge of the calibration of the machines. Mr. Foster worked for seven years at the Bureau of Standards in Washington, certainly an environment conductive to accuracy.

The Bureau of Standards sent one 200,000-lb. compression calibration bar and one 900,000-lb. compression calibration bar to use for the work. These bars were made of steel and were equipped with meters for measuring the decrease in length as pressure was applied. For certain pressures there were certain changes in length. The calibration bars had been accurately tested by the Bureau of Standards, and the meter readings under different loads had been recorded. When the results were plotted on graph paper, a curve was formed which indicated the correlation between the reading of the scale beam and the actual weight which was being applied.

The testing machines, calibrated and adjusted, form the most important part of the general equipment of the station. They will be used in all experiments designed to discover the behavior of materials under heavy loads. Most important of the tests which have been performed in them are the observations of the strengthening effect of concrete encasement to restore corroded beams, results of which give assurance that viaducts and bridges which have deteriorated may safely be continued longer in service.